Title: Compound Your Way to a Million Bucks!

Link to Outcomes:

> • **Problem Solving**   Students will determine the pattern of investment that will yield the highest rate of gain using compound interest.

> • **Communication**   Co-operative learning is stressed as the students investigate the cumulative effects of compound interest. Each learning group will share its results with the class.

> • **Reasoning**   Logical mathematical directions and procedures will be followed. A table of values will be constructed which will be examined, judged, and evaluated.

> • **Technology**   An IBM-compatible computer which supports the software MET (Mathematics Exploration Toolkit) is used to evaluate the compound interest formula from a table of values. Calculators also may be used for those schools with limited access to a computer lab setting.

> • **Statistics**   Students will collect and organize data in table form. They will also calculate percentages of return and net gain from the data collected.

> • **Real-World Application**   The concepts of net gain, compounding, percentages, significant digits, rounding, interest, and scientific notation for large numbers will be used as they relate to money, banking, and investment strategies.

Brief Overview:

Many people save and/or invest for their financial security. Students are often not aware of the strategy behind investing. This exercise will examine the question: "Is there a good, better, and best way to invest in an IRA?" The investment patterns of four people will be evaluated to determine if there is a 'best' way.

Grade/Level:

Grades 8-12 - Consumer Math, Business Math, Pre-Algebra, Algebra I, Algebra II,
 Pre-calculus, Pacesetter Mathematics: Pre-calculus through Modeling

Prerequisite Knowledge:

Students should have knowledge of the following math skills:

- substituting in and solving formulas.
- turning fractions into decimals.
- returning numbers in scientific notation to standard form.
- rounding decimals to two places in monetary applications.
- changing percents to decimals.
- determining net gain.
- calculating percentages.

It is recommended that students have access to and knowledge of at least one of the following technologies:

- computer literacy - loading, running, and editing on MET.
- TI-82 Graphics Calculator (Stat Mode iterations).
- standard calculator.

Objectives:

Students will:

- understand the cumulative effects of compounding interest.
- recognize the difference between compound and simple interest.
- see the correlation between investment patterns and returns.
- become knowledgeable about IRA and its place in investing.

Materials:

- Student Worksheets - Student Resources 1-10
- Teacher Resource
- One of the following technologies:
    - standard calculator.
    - TI-82 Graphics Calculator.
    - IBM computer with MET.

Development/Procedures:

Day 1

This activity should come at the end of a unit on calculating interest. The homework assignment consists of a worksheet the students will complete on the nature of IRA's (Student Resource #1). Also, they will collect data necessary to complete the next day's lab.

Day 2

The teacher will divide the class into four groups. Each group will receive the investing pattern of a different individual (Student Resource #4-8). Using the computer (Student Resource #2) or calculator (Student Resource #3), the students will enter the data and record the answers.

For homework, the students will return all numbers expressed in scientific notation to standard form (Student Resource #9).

Day 3

Results from the other groups will be shared. Observations and generalizations will be made in a group setting using the data gathered in a presentation to the class (Student Resource #10).

Resources:

Kiplinger's Personal Finance Magazine. March 1990. pg.3.

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TEACHER GUIDE
Compound Interest and IRAs

Introduction

Many students fail to grasp the effect of compounding interest upon their money as it compares to simple interest. A vivid illustration of this concept is calculating the projected returns on an account. IRA's are a common vehicle for compounding interest and are known to most students.

This worksheet not only gives the students hands-on experience in the exercise of figuring out the interest but also has the double benefit of illustrating the effects of varying the age the deposits begin and the length of duration.

Another benefit for this exercise is the many faceted review it provides on interest, percentages, changing percents to decimals, scientific notation, significant digits, and net gain. It also is an excellent project for cooperative learning and an excellent way to involve students at varying levels of math ability in the class.

Day 1

After completion of the unit involving percentages and interest, a pre-lab sheet is distributed to each student. This will be completed for homework. (Note: Some teachers may want to discuss IRA's and interest in class and complete pre-lab worksheet as a class/group activity.)

Each group has the option of including an additional investor for bonus points. For these groups, proper data will be given to each group at the same time original worksheets are given. The bonus investor will be <u>Investor B</u>.

Day 2

Divide class into four groups. Assign each group an individual investor, and give appropriate data sheets. Allow students lab time. Give homework sheets which involve the conversion of scientific notation to standard form. (Note: Some teachers may choose to handle the conversion as a class exercise)

Day 3:

Groups will come together to share necessary information for final evaluation. A presentation by each group will be made of its findings to the class. Final Job 2 worksheets will be distributed and completed at this time.

Name_____

PRE-LAB ACTIVITY

IRA

1. What does the abbreviation IRA mean?

    I_____
    R_____
    A_____

2. What is the purpose of an IRA account?

3. List two eligibility requirements for opening an IRA:

    1._____
    2._____

4. Write the names of two types of sources where information on IRAs can be obtained.

5. Find the following information:

    1. the minimum amount needed to open an account_____.
    2. the maximum amount that can be deposited in one year _____.

6. State the penalty for early withdrawal of funds from an IRA.

7. What are the tax benefits of contributing to an IRA?

8. How is the interest rate earned on an IRA linked to the interest rates in general?

9. List three ways an IRA can benefit an individual:

    1._____.
    2._____.
    3._____.

10. Call two sources and obtain the current interest rates for an IRA:

    1. source_____rate_____
    2. source_____rate_____

Bonus: Briefly describe the difference between simple and compound interest:

    *simple interest is found by:

    *compound interest is found by:

Name_____

LAB ACTIVITY - Computer Version
IRA's

Would you like to be a millionaire? I'm sure you probably do. Through compound interest and mathematics, this is possible. But… is there a good, better, or best way to do it so that a maximum return is realized on the money invested?

This lab will explore the investment patterns of four contributors and will compare each to the other. The four people will have differing styles of investing. The variations include the age the program begins, the length of time contributions are made, and the amounts to be deposited.

Set-up: Load MET
            Obtain investor sheet

Procedure:

    1. Type in compound interest formula.
            _____**<enter>**   ASIDE: In the formula
                                                                          at left, what do
                                                                          these letters
    2. Save the formula.   represent?
            ex: sto *a* **<enter>**

    3. Best interest rate offered _____   *d*=_____
                                                             I=_____
                                                             t=_____
    4. Write interest rate as a decimal. _____

    5. Enter your rate for *I*.
            ex: subs .0675 *I* **<enter>**

    6. Enter 1 for the time interval.
            ex: subs 1 *t* **<enter>**

    7. Sto *a*. **<enter>**

    8. Enter investment amount.
            subs (amount) *d* **<enter>**
            ex: subs 500 *d*

    9. Calculate amount.
            ex: simp **<enter>**

10. Obtain decimal value.

      ex: value **\<enter\>**

11. Record amount on worksheet.

12. *a* **\<enter\>**

13. Change the formula to show the interest earned is added to the deposit each time.

      ex: sub *v*+*d* **\<enter\>**   ASIDE: *v* is the

           sto *a* **\<enter\>**   value to

                                            date

14. *A* **\<enter\>**

15. Enter last end of year value found and new deposit amount.

      ex: subs 653.54+2000 *v*+*d*

16. Record amount on worksheet, return to Step 14, and continue until all years are calculated.

LAB ACTIVITY - Calculator Version
IRA's

Would you like to be a millionaire? I'm sure you probably do. Through compound interest and mathematics, this is possible. But… is there a good, better, or best way to do it so that a maximum return is realized on the money invested?

This lab will explore the investment patterns of four contributors and will compare each to the other. The four people will have differing styles of investing. The variations include the age the program began, the length of time contributions were made, and the amounts deposited.

Set-up: Obtain calculator

Procedure:

   1. Write the best interest rate you found offered. _____

   2. Write your interest rate as a decimal. _____   ASIDE: In the formula
                                                                                at left what do
   3. Write the formula for compound interest. _____   these letters
                                                                                represent?
   4.   a) sub in your rate for interest (*I*) _____
        b) sub in the time (*t*) _____   *d*=_____
        c) sub in investment amount (*d*) _____   *I*=_____
        d) rewrite the formula with your values entered _____ *t*=_____

   5. Enter the formula into your calculator. (Follow order of operations.)

   6. Record amount obtained in the worksheet.

   7. Return to Step 3, and repeat until all years have been calculated. Remember to sub in the
      new amount for deposit including the interest earned so far.

Name_____

INVESTOR DATA SHEET
Investor A

Age	Contribution	Year-end Value
8	0	0
9	0	0
.	.	.
.	.	.
40	2000	_____
41	2000	_____
42	2000	_____
43	2000	_____
44	2000	_____
45	2000	_____
46	2000	_____
47	2000	_____
48	2000	_____
49	2000	_____
50	2000	_____
51	2000	_____
52	2000	_____
53	2000	_____
54	2000	_____
55	2000	_____
56	2000	_____
57	2000	_____
58	2000	_____
59	2000	_____
60	2000	_____
61	2000	_____
62	2000	_____
63	2000	_____
64	2000	_____
65	2000	_____

Name_____

INVESTOR DATA SHEET
Investor B

Age	Contribution	Year-end Value
8	0	_____
9	0	_____
10	0	_____
11	0	_____
12	0	_____
13	0	_____
14	0	_____
15	0	_____
16	0	_____
17	0	_____
18	0	_____
19	2000	_____
20	2000	_____
21	2000	_____
22	2000	_____
23	2000	_____
24	2000	_____
25	2000	_____
26	0	_____
27	0	_____
28	0	_____
29	0	_____
30	0	_____
31	0	_____
32	0	_____
33	0	_____
34	0	_____
35	0	_____
36	0	_____
37	0	_____
38	0	_____
39	0	_____
40	0	_____
41	0	_____
42	0	_____
43	0	_____
44	0	_____

45	0	_____
46	0	_____
47	0	_____
48	0	_____
49	0	_____
50	0	_____
51	0	_____
52	0	_____
53	0	_____
54	0	_____
55	0	_____
56	0	_____
57	0	_____
58	0	_____
59	0	_____
60	0	_____
61	0	_____
62	0	_____
63	0	_____
64	0	_____
65	0	_____

Name_____

INVESTOR DATA SHEET
Investor C

Age	Contribution	Year-end Value
8	0	_____
9	0	_____
10	0	_____
11	0	_____
12	0	_____
13	0	_____
14	2000	_____
15	2000	_____
16	2000	_____
17	2000	_____
18	2000	_____
19	0	_____
20	0	_____
21	0	_____
22	0	_____
23	0	_____
24	0	_____
25	0	_____
26	0	_____
27	0	_____
28	0	_____
29	0	_____
30	0	_____
31	0	_____
32	0	_____
33	0	_____
34	0	_____
35	0	_____
36	0	_____
37	0	_____
38	0	_____
39	0	_____
40	0	_____
41	0	_____
42	0	_____
43	0	_____
44	0	_____

45	0	_____
46	0	_____
47	0	_____
48	0	_____
49	0	_____
50	0	_____
51	0	_____
52	0	_____
53	0	_____
54	0	_____
55	0	_____
56	0	_____
57	0	_____
58	0	_____
59	0	_____
60	0	_____
61	0	_____
62	0	_____
63	0	_____
64	0	_____
65	0	_____

Name_____

INVESTOR DATA SHEET
Investor D

Age	Contribution	Year-end Value
8	500	_____
9	750	_____
10	1000	_____
11	1250	_____
12	1500	_____
13	1750	_____
14	0	_____
15	0	_____
16	0	_____
17	0	_____
18	0	_____
19	0	_____
20	0	_____
21	0	_____
22	0	_____
23	0	_____
24	0	_____
25	0	_____
26	0	_____
27	0	_____
28	0	_____
29	0	_____
30	0	_____
31	0	_____
32	0	_____
33	0	_____
34	0	_____
35	0	_____
36	0	_____
37	0	_____
38	0	_____
39	0	_____
40	0	_____
41	0	_____
42	0	_____
43	0	_____

44	0	_____
45	0	_____
46	0	_____
47	0	_____
48	0	_____
49	0	_____
50	0	_____
51	0	_____
52	0	_____
53	0	_____
54	0	_____
55	0	_____
56	0	_____
57	0	_____
58	0	_____
59	0	_____
60	0	_____
61	0	_____
62	0	_____
63	0	_____
64	0	_____
65	0	_____

INVESTOR DATA SHEET
Investor E

Age	Contribution	Year-end Value
8	500	_____
9	750	_____
10	1000	_____
11	1250	_____
12	1500	_____
13	1750	_____
14	2000	_____
15	2000	_____
16	2000	_____
17	2000	_____
18	2000	_____
19	2000	_____
20	2000	_____
21	2000	_____
22	2000	_____
23	2000	_____
24	2000	_____
25	2000	_____
26	2000	_____
27	2000	_____
28	2000	_____
29	2000	_____
30	2000	_____
31	2000	_____
32	2000	_____
33	2000	_____
34	2000	_____
35	2000	_____
36	2000	_____
37	2000	_____
38	2000	_____
39	2000	_____
40	2000	_____
41	2000	_____
42	2000	_____
43	2000	_____
44	2000	_____

45	2000	_____
46	2000	_____
47	2000	_____
48	2000	_____
49	2000	_____
50	2000	_____
51	2000	_____
52	2000	_____
53	2000	_____
54	2000	_____
55	2000	_____
56	2000	_____
57	2000	_____
58	2000	_____
59	2000	_____
60	2000	_____
61	2000	_____
62	2000	_____
63	2000	_____
64	2000	_____
65	2000	_____

Name_____

Post-Lab Activity
IRA

While working on the lab activity sheet, you should have noticed that many of the numbers appeared in strange looking format (ex: 2.365E+04). This is because of a function of the program that puts numbers of a certain size automatically into scientific notation. To change the number back into standard form move the decimal to the right the number of places indicated after the "+" sign. (ex: 2.365E+04 -> 23,650).

Job 1- List below all the numbers from your sheet in standard form:

Age	Year-end value		Age	Year-end value
8	_____		38	_____
9	_____		39	_____
10	_____		40	_____
11	_____		41	_____
12	_____		42	_____
13	_____		43	_____
15	_____		44	_____
16	_____		45	_____
17	_____		46	_____
18	_____		47	_____
19	_____		48	_____
20	_____		49	_____
21	_____		50	_____
22	_____		51	_____
23	_____		52	_____
24	_____		53	_____
25	_____		54	_____
26	_____		55	_____
27	_____		56	_____
28	_____		57	_____
29	_____		58	_____
30	_____		59	_____
31	_____		60	_____
32	_____		61	_____
33	_____		62	_____
34	_____		63	_____
35	_____		64	_____
36	_____		65	_____
37	_____			

JOB 2- ANALYSIS

You will need to refer to the front sheet of this handout and also get information from the other teams in order to complete this section.

1. State the total amount invested for each contributor.

    A _____
    B _____
    C _____
    D _____
    E _____

2. State the total amount earned by age 65 for each contributor.

    A _____
    B _____
    C _____
    D _____
    E _____

3. Calculate the net earnings for each of the above.

    A _____
    B _____   ASIDE: how do you calculate
    C _____   net earnings?
    D _____   _____
    E _____   _____

4. Find the percentage of return on investment for each person.

    A _____
    B _____   HINT: net earnings
    C _____   ---------------
    D _____   total invested
    E _____

Questions:

1. Which group ended with the most money?_____
2. Which group invested the most money? _____
3. Which group invested the least money? _____
4. Which group had the highest return? _____
5. Make a generalization about the effect of the age you begin investing and the returns.

6. Make a generalization about the effect of continuing deposits until the age of 65 as opposed to stopping at an earlier age.

7. By looking at the records of deposits for all the groups, what would you find to be generally true. If deposits can be made only for a short time, it is best to make them _____ _____.

8. Justify your answer to question 7:_____ _____.